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something or other which we presume does take place when the error is large. From this point of view therefore a run of luck is as much a disturbing cause as an observer's blunder, and so I regard it; but this is of course not the meaning that Mr. Stone and some others would assign.

I may, in conclusion, allude to what has been sometimes urged as an objection to the law $\frac{h}{\sqrt{\pi}}e^{-h^2x^2}$, viz., that an error, however large, is possible. But such ought to be the case in an infinite number of observations; for, even if we could limit the continuous errors, we can set no bounds to the blunders. In practice we reject the mistakes directly we recognise them as such, but in an infinite series of observations, where everything is left to the theory, it applies to them as well as to any other class of errors. In the case of a mural-circle observation one might suppose that no one could by any carelessness make an error of more than 180°, nor can any one in reading the instrument, but the observer might register the observation as 1105° instead of 105°, when a greater error is introduced. It is, of course, not true that a really infinite error is possible, as the probability is proportional to $e^{-\infty^2} = 0$. Another point deserving notice is the statement usually received as self-evident, that positive and negative errors are equally probable. In certain conceivable cases this seems at first sight not to be the case; for, suppose one were to estimate the area of a field containing, say two acres, then it would be quite possible to say four acres, or even six, but absurd to say zero, or minus two (a case of this kind was pointed out to me by a pupil, in my lectures this term, as an exception to the rule). It is a sufficient justification of such an apparent exception to observe that an estimation (or guess) is not of the nature of an observation, as contemplated in the theory of errors; but still the analogy is close enough to make the discrepancy worth remark. The corresponding case in the theory of errors would be, if we had to measure a length so small that it was comparable with the errors of observation; a matter which would not in general be attempted. But if we were engaged with such a question, and a and b the abscissæ of the zero extremities of the length were observed, we should, of course, retain the values of $a - b$, whether positive or negative (viz. the mere fact of the length being negative, would be no ground *per se* for rejection).

Cambridge; 1873, *April* 2.

On the Eclipses mentioned in the Anglo-Saxon Chronicle.

By the Rev. S. J. Johnson.

Not having met with any work containing a description of the above, I have forwarded the following results to the Society

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hoping they may prove of interest to some of the members. The computations I have made from the expeditious tables given in the *Encyclopædia Britannica*, but they may be expected to afford a very fair approximation to the truth. The edition of the *Saxon Chronicle* employed is that by Thorpe, published under the direction of the Master of the Rolls in 1861.

A.D. 538. "In this year the Sun was eclipsed fourteen days before the Calends of March from early morning till nine." I believe this is notable as the first eclipse of which we have any record as occurring in this country. I make the greatest obscuration to have amounted to two-thirds of the Sun's diameter at London about 7^h 43^m A.M. on Feb. 15. In Tycho Brahe's *Historia Celestis** it is referred to in these words, "Eclipsis solis annotata invenitur apud scriptores Anglos, quæ acciderit die XV Calend. Martii sive XV Feb. anno quinto Henrici regis West-Saxonum in Anglicâ, hora diei primâ usque fere ad tertiam sive statim post ortum solis."

540. "In this year the Sun was eclipsed on the 12th of the Calends of July, and the stars appeared full nigh half an hour after nine." The middle of this eclipse comes out at London about 7^h 37^m A.M., and the magnitude very nearly the same as in 538. It is mentioned in T. Brahe's *Historia* and in Struyk's list of eclipses given in Ferguson's *Astronomy*. Both give a similar magnitude to that I have obtained. The semi-diameter of the Sun was nearly as small as it can be, that of the Moon nearly as large as possible. The question arises, How are we to explain the notice of the stars showing themselves when totality would take place far south of England? I can only say the account must be taken from the narrative of those who saw it where the magnitude was greater than in this country.

664. "In this year the Sun was eclipsed on the Vth of the Nones of May; and Earcenbryht, king of the Kentish people, died, and Ecgbryht his son succeeded to the kingdom." On May 1st I find a very large partial eclipse of the Sun, the maximum at London soon after 5^h P.M. with a thin crescent uncovered at the south of the Sun's disk. It would seem to have been total in this country.

733. "In this year Ethelbald captured Somerton; and the Sun was eclipsed, and all the Sun's disk was like a black shield; and Acca was driven from his bishopric." The eclipse must have been upon August 14th, when I find a very large one took place, which according to these tables was annular in England, the greatest phase at London about a $\frac{1}{4}$ past 8^h in the morning, when I find for the Sun's semi-diameter, $15' \, 54''$, the Moon's, $15' \, 22''$. Tycho Brahe's *Historia Celestis* speaks of it as "circiter horam diei tertiam pene totus orbis solis nigerrimo et horrendo scuto videretur obtectus." In Humboldt's *Cosmos*, vol. iii. part ii. seventeen instances are given in a note, of sudden diminutions of

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* There is a fine copy of this work in the Library of the Society.

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the light of day, Humboldt treats them as meteorological phænomena, and doubtless some may be disposed of in that way, as, for instance, that in 45 B.C. about the death of Cæsar. But I think in his notice under 733, the above eclipse is alluded to, "A year after the Arabs had been driven back beyond the Pyrenees as the result of the battle of Tours, the Sun was darkened on the 19th of August in a terrifying manner."—Schnurrer, *Chron.*, Th. 1, S. 164. This must be the first annular eclipse in England, of which we have any record.

795. "In this year the Moon was eclipsed between cock-crowing and dawn on the Vth of the Kal. of April; and Eardwulf succeeded to the kingdom of the Northumbrians on the IInd of the Ides of May." The eclipse mentioned must be that of March 28, 796. In the former March I find no eclipse, but on the morning of the latter date, one began about 4^h, and the Moon would set during the total phase.

802. "In this year the Moon was eclipsed at dawn on the XIIIth of the Kal. of January (Dec. 20)." Some mistake about the date. The full Moon in Dec. 801 was on the 23rd, and was not eclipsed, nor were the full Moons in Dec. 800 or 802. I find an eclipse on the XIIIth of the Calends of June, not January, or in the night of May 20–21, 802, which I fancy must be that alluded to. It commenced about 2.20 A.M., and was nearly total a few minutes before sunrise.

809. "In this year the Sun was eclipsed in the beginning of the fifth hour of the day, on the XVIIth of the Calends of August, on the second day of the week, the 29th of the Moon." I find an eclipse on July 16th, not however very remarkable, greatest phase by these tables about 9.22 A.M., magnitude 7-tenths on the Sun's upper limb. By the fifth hour of the day we must no doubt understand the fifth hour from sunrise. So the account in the Chronicle is very exact.

827. "In this year the Moon was eclipsed on midwinter's mass-night, and the same year King Ecgbryht subdued the kingdom of the Mercians, and all that was south of the Humber." The date given is wrong again. The eclipse on the morning of Christmas Day 828, must be here meant. It commenced about a quarter past midnight, and after passing through a total phase, ended about a quarter to four in the morning. This must have taken place about the time when Egbert triumphed over opponents and united the several Anglo-Saxon nations into one powerful monarchy.

879. "The Sun was eclipsed one hour of the day." No month is given. By examining the new Moons I found the Sun eclipsed only so as to be invisible to England this year. But in 878 there was a great eclipse on October 29, which I have little doubt is the one here referred to. T. Brahe's *Historia Celestis* gives the following notice of it, "Ait autem auctor vitæ Ludovici solem post horam nonam ita obscuratum esse, ut stellæ in cœlo apparerent, et omnes sibi noctem imminere putarent." The tables

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in the *Encyclopædia* gave totality at London about $1^h\ 14^m$; and Mr. Hind has informed me by a more recent and rigorous computation that totality came on at $1^h\ 6^m\ 20^s$, and lasted nearly two minutes. A note in Thorpe's translation of the Chronicle says, "The eclipse happened on March 14, 880," but as that eclipse was at sunset, and nowhere total, it can hardly be here signified. I have examined each year from 878 to 1715, and have not succeeded in finding another eclipse that appears to have been total at London.

1110. "On the fifth night in the month of May, the Moon appeared in the evening, brightly shining, and afterwards by little and little its light waned, so that as soon as it was night it was so completely quenched, that neither light nor orb, nor anything of it was seen. And so it continued very near until day, and then appeared full and brightly shining. It was on this same day a fortnight old. All the night the air was very clear, and the stars over all the heaven brightly shining. And the tree-fruits on that night were sorely nipt." I find the Moon, by these tables, entered the Earth's umbra about 9^h, and emerged from it about $12^h\ 30^m$. The expression "neither light nor orb, nor anything of it was seen," is curious, and seems to me to indicate this as a case of the disappearance of the Moon during totality, perhaps the first recorded instance of that peculiarity. Humboldt in *Cosmos* (Art. "Solar Domain") says, "In total lunar eclipses it happens in some exceedingly rare cases that the Moon disappears wholly; it did so according to Kepler's earliest observation on the 9th of December, 1601." Humboldt's and other popular works give four other instances of this, 1620, 1642, 1761, 1816. On calculating the eclipse of 1601, I find it was not total, about nine-tenths of the Moon's surface dipping into the Earth's shadow. In a curious old work in my possession by Cyprianus Leovitius, the Bohemian astronomer (entitled *Eclipsium omnium ab anno* 1554 *usque ad annum* 1606 *accurata descriptio et pictura*), this is drawn as an eclipse of 11 digits. I see there is a long description of it in the *Paralipomena* to T. Brahe's *Hist. Celest.*, but no mention of the disappearance of the Moon. In 1620, however, two total lunar eclipses are mentioned in that work, one on June 14, the other on December 9, in both of which the Moon is stated to have shown with peculiar obscurity during the total phase. It seems to me, therefore, that astronomical writers in future must regard Dec. 9, 1601, as a mistake for Dec. 9, 1620. Of the eclipse of June 14, 1620, it is said, "The Moon was seen with great difficulty, it shone moreover like the thinnest nebula, far fainter than the Milky Way, without any coppery-tinge" (*rubedine*). About the middle of the second hour nothing could be seen of the Moon with the naked eye, and through the telescope (*tubum*) something was detected so uncertainly that no one could tell whether the Moon was not something else. Of the Eclipse of Dec. 9, there is this entry, "Deinceps luna omnino disparuit, ut nihil de eâ videretur, clarè aliis circumcirca stellis

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lucentibus, et sic exul, amissaque luna perstitit uno quadrante paulo plus."[*]

I have omitted seven other lunar eclipses mentioned in the *Chronicle* as the dates given agree with the calculation, and they present no special feature of interest. The total solar eclipses of 1133 and 1140 have been so thoroughly described by Mr. Hind that there is no need to refer to them. In each case by projecting for London with elements from these tables, I obtain a small crescent at the south of the Sun's disk.

Upton-Helions Rectory, Crediton, Devon,
February 22.

Note on the Distribution of Resolvable and Irresolvable Nebulæ. By Sidney Waters, Esq.

(*From a Letter to Mr. R. A. Proctor.*)

Whilst studying the nebulæ and their distribution it occurred to me that if the resolvable and irresolvable nebulæ were charted down with some prominent distinctive characteristic, light would be thrown on the question, 'Is resolvability any test for distance?'

Lately I have begun to test this, and have met with such remarkable results that I am induced to trouble you with a few remarks. First, I would state that I copied the meridians and parallels laid down on Map 2 of your large Atlas, only altering the hours of R.A. from 22, 23, 24, &c., to 10, 11, 12, &c., it appearing that this map then included the most interesting nebular regions; and, further, having marked in the meridians and parallels to every 4 minutes in R.A., and every degree in N.P.D., I plotted in the nebulæ from Herschel's catalogue, marking in the resolvable nebulæ in red ink, the irresolvable nebulæ in black (by resolvable I include all objects marked *r*, *r r*, *r r r*, *e r*, Cl). This done, a glance shows, that there is a most remarkable connexion between the resolvables and the irresolvables, that where the irresolvables cluster there also do the resolvables.

The following statement seems to confirm this view. The whole map contains about 1284 nebulæ, of which 157 are resolvable; this is about the proportion of 10 resolvables to 80 irresolvables.

A space bounded by R.A., 12^h and 13^h, and N.P.D. 70° and 90°, contains 266 nebulæ, of which 49 are resolvable; this is in about the proportion of 10 to 54, but this space occupies only about $\frac{1}{15}$th of the map, so that if the nebulæ were as richly spread

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[*] In the Eclipse of July 12, 1870, I noticed the Moon's disk much duller and the coppery tinge much fainter than is usual during totality. From 9.55 to 10.15 I was unable to detect some portions of the eastern limb, either with the naked eye or telescope.